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The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by LEON GASTER

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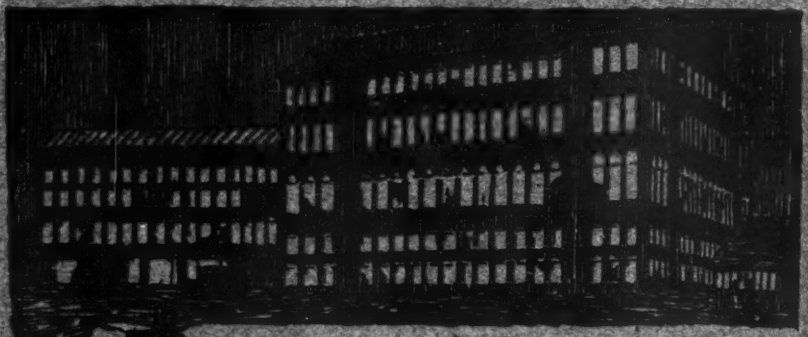
This number contains an account of the proceedings at the ANNUAL MEETING of **The Illuminating Engineering Society** held on May 26th, the **Report of the Council** for the Session Nov., 1923—May, 1924, and some contributions to the discussion on the **Daylight Lighting of Textile Factories.**

Other items include:

ILLUMINATION AT THE WORLD POWER CONFERENCE—THE ILLUMINATION OF FACTORIES—PRESENT PRACTICE IN MOTOR BUS LIGHTING—DEFINITIONS IN CONNECTION WITH SEARCHLIGHTS—ARTIFICIAL DAYLIGHT, ETC.



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EDITORIAL.

Illumination at the World Power Conference.

At the sectional meeting of the World Power Conference held at the British Empire Exhibition on July 4th three papers dealing with various aspects of illumination were read. As there were some hundreds of papers before other sections, dealing mainly with problems of generation and transmission, etc., the proportion devoted to lighting appears small. This was remarked on by Dr. Clayton Sharp, who opened the discussion. It is estimated that on the average at least 50 per cent. of the electrical energy generated throughout the world is used for lighting. The question of the best use of the energy for purposes of illumination therefore well deserves study.

The three papers together covered a wide ground. Mr. J. W. T. Walsh, in reviewing the work of the International Illumination Commission, remarked that its activities are as yet in their infancy. It is only recently that the threads broken during the period of the war have been taken up again, but much useful work is now being done, and the Commission once more provides an effective means of securing interchange of views between experts in different countries. One notable respect in which the present body differs from the old "International Photometric Commission" is that its field of activities, already including such matters as automobile

headlights and the lighting of schools and factories, is considerably wider. There is no doubt that it will play an important part in deciding questions of international interest, and it is essential that at future gatherings this country should continue to take a leading part.

The second paper, by the writer, reviewed both national and international developments of illuminating engineering, showing how in this country the Illuminating Engineering Society acts as a "liaison officer" between many different bodies interested in various aspects of illumination; that it serves as a centre for information on all problems relating to the use of light; and that its work, while of genuine national benefit, is also of the greatest service to the lighting industry.

A very comprehensive paper, by Mr. C. W. Sully, traced the development of the electric lamp, discussing its application in many different fields of lighting, and quoting statistics to illustrate the benefits of good illumination. Since the illuminating engineering movement was initiated there has been a distinct advance in the amount of illumination used in this country. Mr. Sully mentioned that for the years 1912, 1917 and 1922 the average wattages of lamps sold were 36·1, 46·8 and 57·4—a result of education of the public to a more generous appreciation of the value of good lighting. It was pointed out, however, that the mere use of more powerful lamps alone is of little benefit unless they are wisely applied.

In the final section of his paper Mr. Sully pointed out the immense amount of work before the lighting industry in equipping buildings and streets with proper methods of lighting. He estimated that there were over 250,000 factories and over 750,000 offices needing artificial light, and quoted similar large figures for stores and other interiors. After reviewing the data he arrived at the conclusion that £47,975,000 might be profitably expended in re-equipping such buildings to modern recommendations, and £343,340,000 in the equipment of unwired buildings.

With such prospects of remunerative work the lighting industry can well afford to encourage any movement designed to promote public appreciation of the benefit of good illumination. From such a movement makers of lamps and lighting appliances (globes, reflectors, etc.) derive immediate benefit. But this benefit also extends to makers of cables, who will find increased demands for the wiring of buildings, supply undertakings, whose load will be increased, and ultimately plant manufacturers, whose services will be needed to provide machinery to generate additional electrical energy.

Thus a movement for better lighting reacts favourably in many directions, and should receive the support of all those who may expect benefit from it. But for this reason it is desirable that the movement should be primarily under the direction of the Illuminating Engineering Society which, besides representing the lighting industry, acts as the "guardian of public interests in matters of illumination."

In conclusion an expression of thanks is due to Mr. D. N. Dunlop and his colleagues associated with B.E.A.M.A. for their efforts in organising the World Power Conference—a truly international event in which engineers from all parts of the world took part.

Future Developments in Electric Lighting.

In connection with electric lighting, as with gas lighting, we sometimes find a tendency to assume that the lighting field is " saturated " and will in future tend to form a smaller and less important proportion of the total load. However this may be it is well to remember that, according to Dr. Clayton Sharp's estimate, lighting still consumes about half of the world's supply of electricity; and in many areas much more than this. It is doubtless true that new applications of electricity, especially for industrial power, are continually being developed, but the demand for lighting grows at the same time.

We notice that Sir Alexander B. Kennedy, in his paper before the World Power Conference, seemed inclined to under-rate the importance of the lighting load. Nevertheless he admitted, what is common knowledge, the vastly increased standard of lighting during recent years, remarking :—" Our experience of the last five and twenty years has, however, indicated unmistakably that the more light people use, the more they want to use. In other words, that the standard of domestic illumination, as well as illumination generally, has risen enormously as the means of gratifying it have increased. The use of the more economical lamps has apparently not diminished the demand for watts, it seems only to have increased the demand for candlepower."

What is true of domestic lighting is still more true of other fields, for example, industrial lighting. Many of the hundreds of thousands of factories and workshops are still inadequately lighted. Other cases, streets, schools, libraries, public buildings, etc., could be mentioned where reforms in lighting are badly needed, and the readiness with which people can be induced to conform to modern requirements depends on the energy and wisdom with which propaganda in favour of better lighting is developed, and on the status of the lecturers.

Another point that should not be overlooked is the continual new applications of light—quite as remarkable as those in connection with power. Sir Alexander Kennedy mentions as an instance the use of electricity for external advertising, which has made such rapid progress in London during recent years. Again, in applications of electricity to agriculture, which may be expedited considerably by developments in bulk supply during the next few years, lighting will form a valuable supplement to other loads and in forms not generally realised as yet. Proper illumination of farm buildings, cowsheds, etc., has been proved to have an important bearing on the cleanliness of operations and the speed with which they can be carried out. There are other special applications, such as the use of artificial light as an aid to horticulture (mentioned in our last issue*), and as a means of controlling the output of eggs and the giving of milk by cows, little explored as yet, but with interesting possibilities.

Finally, when the time ever comes when a network of wires brings abundant electricity within the reach of every one in these isles, even in the most remote country regions, people will no longer be content with semi-darkness but will gratefully accept conditions of illumination as good as those provided in the towns. It may confidently be said, therefore, that in any future developments in the demand for electricity, lighting will continue to play an important part.

* ILLUM. ENG., May, 1924, p. 64.

Developments in Flood-lighting.

In drawing attention to the increasing number of examples of flood-lighting of the exteriors of buildings in London, we have remarked on the need for discrimination in the higher branches of this art, in which the architect should be consulted. The primary difficulty, from the æsthetic standpoint, is that shadows cast by projections on buildings are normally caused by overhead light coming from the sky, and the architectural design is based on the appearance of the building in daylight. Unfortunately it is usually difficult to ensure, in the case of flood-lighting, that the light comes from the same direction. The surface of the building may be illuminated by a distant projector, or by means of shaded sources placed a few feet from the face of the building, *e.g.*, under cornices, etc. In either case, whilst spectacular and striking effects from the advertising standpoint may be obtained, it is difficult to avoid some degree of shadow-distortion. Apparently better results are possible in cases when a number of sources can be mounted on posts, ten to twenty feet from the face of the building and shielded on the side facing the street. But it is only rarely that this method can be used, and, if the space between the lights and the building is free for the passage of people, their eyes are apt to receive the full glare of the lamps, and their persons may cause moving shadows.

These and other problems were discussed in a recent paper by Messrs. Arthur U. Gerber and E. A. Tillson, the former an architect, the latter a lighting expert, read before the Illuminating Engineering Society (U.S.A.). Joint effort by an architect and an illuminating engineer forms a hopeful method of attacking the problem, and it is much to be desired that this question of artificial lighting of the exteriors of buildings should receive more attention from the architectural profession. In this case one interesting possibility was suggested, the deliberate design of faces of buildings for the purpose of illumination by night. In the case of certain types of buildings for which flood-lighting is intended, this procedure has much to recommend it. It should be possible to devise convenient means of concealing the sources from view and even to select ornamentation that would not suffer unduly from the unusual direction of the light.

A further question discussed in this paper, and illustrated by the aid of small models, was the use of colour in flood-lighting. It was pointed out that while architecture in the sunny southern districts of Europe has proceeded on somewhat florid lines, coloured surfaces being commonly used, in northern Europe the tendency has been towards restrained use of colour. For most buildings of distinction a grey neutral coloured stone is preferred. This is due doubtless partly to atmospheric conditions and presence of smoke in large cities, which are unfavourable to the use of paint, and also to the fact that certain coloured materials, such as variegated marble, happen to be more accessible in southern Europe. The suggestion is now made that coloured light should be used for flood-lighting, and that in this way striking and even harmonious and artistic effects might be secured. Certainly this offers a fruitful field for study, and where spectacular effect is desired the idea has much to recommend it. Flood-lighting with white light is apt to have rather a monotonous and "ghostly" effect. On the other hand the colours should not be too vivid and would have to be selected with care. Here, again, is an opportunity for the architect to exert his influence, guiding this innovation on tasteful lines.

LEON GASTER.

TRANSACTIONS

OF

The Illuminating Engineering Society.

(Founded in London, 1909.)

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

PROCEEDINGS AT THE ANNUAL MEETING.

(Held at the offices of the Society, 32, Victoria Street, London, S.W 1, at 5 p.m. on Monday, May 26th, 1924.)

THE Annual Meeting of the Society was held at 32, Victoria Street, London, S.W.1, at 5 p.m. on Monday, May 26th, Dr. JAMES KERR in the Chair.

The Minutes of the last Meeting having been taken as read the HON. SECRETARY read out again the names of applicants for membership announced at the last meeting, who were formally declared members of the Society.

The HON. SECRETARY then presented the Report of the Council for the Session November, 1923—May, 1924 (see pp. 95-98). After summarising proceedings at meetings during the past session the Report referred to the numerous instances of co-operation with other bodies, and International developments. Attention was drawn to the forthcoming International Conference on Industrial Hygiene, and the meeting of the International Illumination Commission to be held in Geneva during July. The need for widespread propaganda on illumination was also emphasised and it was mentioned that the Council had expressed approval of steps for extending the official organ, THE ILLUMINATING ENGINEER, and rendering it more popular in treatment, so as to appeal to a larger circle of readers.

The following Resolution was then proposed by Mr. J. W. T. WALSH, seconded by Mr. W. A. BISHOP, and carried unanimously :—

> "That the Annual Report of the Council for the Session 1923–4 be adopted, and that a vote of thanks be moved to the Council and Officers of the Society for their services during the past session."

Mr. WALSH, in moving the Resolution, drew attention to the extending scope of the work of the Society. The past session had been one of exceptional activity and much useful propaganda had been undertaken in various directions, apart from discussions at meetings. It was generally agreed that the time was ripe for adequate support to be given to the movement so that these extending operations could be conducted on a proper scale.

The Chairman then recalled that Sir JOHN HERBERT PARSONS, after two years of office, had expressed a desire to relinquish the Presidency and that the Council had already expressed their great appreciation of his services to the Society during this period. Mr. C. H. WORDINGHAM, a past president of the Institution of Electrical Engineers, who

had presided at meetings of the Society in the past and took a great interest in the subject of illumination, had kindly consented to accept nomination as President for the forthcoming Session, and the Council felt that the Society would be fortunate in securing his services.

The Council had also nominated two new members, Mr. J. Y. FLETCHER and Mr. J. W. BEAUCHAMP (Director of the Electrical Development Association), whose assistance in developing the work of the Society should be of considerable value.

The following Resolution was accordingly proposed by The CHAIRMAN and seconded by Mr. L. GASTER and declared carried unanimously :—

"That Mr. C. H. Wordingham be elected President of the Illuminating Engineering Society for the Session 1924-5 ; that Sir John Herbert Parsons (Past President), Mr. Frank Bailey and Sir William Bayliss (Members of Council) be elected Vice-Presidents of the Society ; that Mr. J. Y. Fletcher and Mr. J. W. Beauchamp be elected Members of Council."

In conclusion the following Resolution was proposed by Mr. A. BLOK, seconded by Mr. J. W. T. WALSH and declared carried unanimously :—

"That this meeting desires to express a cordial vote of thanks to the Royal Society of Arts for the courteous permission to make use of their rooms during the past Session and records its appreciation of the encouragement and support which the Society has received."

This ended the formal business before the meeting and the Chairman announced that the opening meeting of the next session would be held during November. The Council is now considering the programme for the next Session and will be glad to hear from any members who are prepared to read papers or open discussions.

OBITUARY.

Dr. Ernest Fox Nichols.

We record with great regret the death of Dr. E. F. Nichols, the author of many outstanding researches in the field of radiation and spectrophotometry, which occurred with dramatic suddenness in the course of a brilliant lecture before the National Academy of Sciences. The lecture dealt with a fascinating problem—the exploration of the little known region between the infra-red and the electric wave spectra. From the account of the incident given in the Transactions of the Illuminating Engineering Society (U.S.A.) it appears that when the lecturer paused in his address and sat down none of his audience imagined that it was more than a slight indisposition. Yet in a few moments all was over.

Dr. Nichols was one of the earliest physicists to identify himself with the study of photometry and the underlying principles of light production and he had the gift of imparting to his addresses much of the romance associated with his subject. He had also a broad outlook on the subject of illuminating engineering and his work illustrated very clearly the value of the services of an authority who can take a lofty and independent view.

One of his last duties to the Illuminating Engineering Society in the United States was the presentation of his report as chairman of the Committee on Research. In discussing investigations on the relation of illumination to the efficiency of industrial operations he emphasised the desirability of this research having a public and authoritative character, rather than being identified with the lamp industries or central stations. For this reason, he explained, it had been decided to place the experiments in the hands of the National Research Council.

The work of Dr. Nichols was followed with close interest in this country and the news of his passing away will be learned with genuine regret by all concerned in illuminating engineering.

REPORT OF THE COUNCIL FOR THE SESSION
(November 1923–May 1924).

(Presented at the Annual Meeting of the Society, held at 32, Victoria Street, at 5 p.m. on Monday, May 26th, 1924.)

DURING the past Session there have been several interesting discussions which have enabled the Society to extend its influence in various directions. Four additions have been made to the list of kindred bodies whose Presidents or appointed representatives became, during their tenure of office, members of the Council of the Illuminating Engineering Society, namely: The British Electric and Allied Manufacturers Association (Mr. C. Rodgers), The National Institute of Industrial Psychology (Mr. Eric Farmer), the Institution of Public Lighting Engineers (Mr. S. B. Langlands) and the Women's Engineering Society (Lady Parsons).

Sir John Herbert Parsons, after two years of office, is relinquishing the Presidency and the Council desires to take this opportunity of putting on record their appreciation of his services to the Society, notably in connection with all questions relating to the effect of light on the eye. Mr. C. H. Wordingham, a past President of the Institution of Electrical Engineers has kindly consented to accept nomination as President for the coming session. The active interest which Mr. Wordingham has taken in illumination is well known to members of the Society, and his wide outlook in these matters should be of great value to the Society during his tenure of office.

During the past year two eminent men associated with illuminating engineering in the United States have passed away, Dr. Louis Bell and Dr. C. P. Steinmetz, and special obituary notices have appeared in the journal. We have also to record with regret the death of Mrs. Hertha Ayrton, whose name will always be associated with her pioneering researches on the electric arc and M. Violle, the inventor of the platinum standard of light.

MEETINGS OF THE SOCIETY.

The opening meeting of the Society on November 13th, 1923, was devoted to reports of progress and exhibits illustrating developments in illuminating engineering. The report of the Committee on Progress in Electric Lamps and Lighting Appliances showed that the past year was one of steady development, especially as regards standardisation. Notes on developments in gas lighting were contributed by Mr. J. G. Clark and Mr. Philip Sugg and the exhibits included new forms of gasfilled lamps, various devices illustrating the use of colour in illumination, a new form of headlight for motorcars, etc.

On December 11th a discussion on "The Application of Scientific Illumination in Practice" was opened by Messrs. G. Herbert and R. A. Ives. Attention was drawn to the value of statistical data on the effect of conditions of illumination on safety and production, and methods of approaching the consumer were discussed.

The discussion on "Co-ordination of Research in Illuminating Engineering" opened by Mr. J. S. Dow on January 22nd, 1924, formed a useful supplement to the previous paper in suggesting methods by which the Society could be of service both to the lighting industry and the general public. Researches were classified according to the best means of carrying them out, and it was pointed out that problems affecting a large section of the community (such as the conditions of illumination desirable in various important industries) could only be determined by a representative body, able to speak with impartiality and authority. The Society, however, could only cope with its rapidly extending work by the aid of other bodies; it should act as a "liaison officer" suggesting profitable subjects for research and devising means of carrying them out.

On February 19th a discussion on "Traction Lighting by Electricity" was opened by Messrs. J. F. Caine and E. A. Marx, Jr. After referring to previous papers before the Society dealing with railway lighting, the authors discussed

in turn the lighting of railway carriages and public vehicles, and the illumination of platforms, station names, etc. Representatives of a number of leading railway and tramway systems took part in the ensuing discussion.

The next subject "The Use of Light in Modern Advertising," discussed on March 21st, 1924, was also one with which the Society had dealt previously; but the opportunity was taken of considering various recent developments in connection with this wide subject. Mr. G. P. Garbett gave an illustrated account of modern outdoor illuminated signs, especially those of an "animated" character, and referred to the need for simplification of the existing complex and varying regulations imposed in different cities. Miss M. Partridge dealt mainly with show-window and display lighting, endorsing the principles which the Society has recommended in regard to avoidance of glare and giving a description of the neon signs, one of which was shown in operation at the meeting. The view was expressed that these problems afford a very favourable field for the Society's efforts, in view of the need for co-ordinating the views of sign-manufacturers, advertisers and the public.

The final meeting, on April 28th, was devoted to papers on the "Lighting of Textile Mills." Mr. Ernest L. Oughton gave an account of experiences in the lighting of such factories by gas, describing the chief modern low pressure and high pressure systems and showing, by the aid of numerous sketches and diagrams, how lights should be arranged for various processes. A paper by Mr. P. J. Waldram drew attention to some of the complex problems that arise in connection with access of light into textile mills, where the conditions of temperature and humidity, and the effect thereon of large glass areas, have to be very carefully considered. The conditions requisite for the various processes differ considerably and there is room for much further research in this field. In particular it was pointed out how, in certain instances, an estimate of access of daylight is affected by the consideration that illumination in a vertical plane is chiefly desired. The subject is one that deserves full discussion at one of the chief textile centres in the north of England, and it is hoped to arrange a joint meeting for this purpose in the near future, for which the papers referred to would serve as a useful basis.

Co-operation with Other Bodies.

As usual, the discussions during the Session have provided opportunities for co-operation with other bodies, and in other respects this feature of the Society's work has been fully maintained. By its representation on the London Safety First Council the Society has been able to interest this body in the relation between good public lighting and street safety, and it is hoped to obtain in due course more complete data showing the connection between inadequate illumination and accidents. A new edition of the illustrated booklet entitled *Good Lighting as an Aid to Safety* has been issued by the British Industrial Safety First Association and will doubtless help to bring this matter before the notice of manufacturers throughout the country. As mentioned above the National Institute of Industrial Psychology has consented to appoint a representative on the Council of the Society, and this should aid the study of many problems in which both bodies are interested. Several investigations recently undertaken by the Institute have shown the direct relation between conditions of lighting and the ease and speed with which work can be done; the assistance of the psychologist should also be useful in connection with the use of light for advertisement, etc.

The formation of the Institution of Public Lighting Engineers is a step of interest and the Society was well represented at their inaugural meeting on February 15th. It is now widely recognised that the public lighting of large cities should be placed in the hands of qualified experts. The interchange of views among those concerned with street-lighting should help towards the realisation of the aims which the Illuminating Engineering Society has in view.

The Illuminating Engineering Society has been invited to participate in the

work in connection with the National Register of Electrical Installation Contractors, and, in common with other leading bodies, is represented on the Registration Board. Members of this Society will view with sympathy any steps calculated to raise the status of the contractor, whose aid we are most anxious to secure.

A noteworthy step, already recorded in the official organ, has been the appointment by the Department for Scientific and Industrial Research, of a Committee on Illumination, in which lighting experts, architects, physiologists and others concerned with illumination take part. This Committee should furnish a valuable means of initiating researches on lighting problems and has already commenced work on several important questions.

The National Illumination Committee has carried out a considerable amount of useful work during the past year, which is summarised in the Chairman's recent report. An event of great interest is the decision, following a conference called by the British Engineering Standards Association, to form a sectional committee, of which the National Illumination Committee will form the nucleus. The formation of this Committee will, it is hoped, accelerate standardisation in illumination matters, and is a gratifying recognition of the progress that has been made towards agreement on the chief principles of illumination.

Propaganda on Illumination.

In discussions before the Society importance has been attached to increased propaganda in favour of good lighting. It is felt that the time is ripe for more extensive efforts to reach a wider circle, and various methods of effecting this are being considered. Enterprise has been shown by several of the leading firms in the lighting industry in arranging demonstrations. These should form a valuable supplement to the work of the Society, in bringing home the conclusions arrived at in its discussions. The project of preparing a textbook on illumination for use in colleges is also being considered, and it is hoped that the preliminary arrangements will be completed in the near future. Several members of the Society have given lectures on illumination before popular audiences and, by the kind arrangement of the British Broadcasting Co., Ltd., the Hon. Secretary has given two talks: the first dealing mainly with the lighting of the home, school and office; the second with lighting in industry and public service. A short talk on illuminating engineering was also given by Mr. L. Gaster and J. S. Dow to the Institution of Electrical Engineers on March 17th. The holding of the National Gas Exhibition in Birmingham during September last also afforded a useful opportunity of interesting the public in illumination, and it is hoped that the British Empire Exhibition at Wembley will likewise provide an opportunity of making the work of the Society more widely known. At the World Power Conference a paper is to be read by the Hon. Secretary, explaining the aims of the movement, and the national and international aspects of the work entailed.

Extension of "The Illuminating Engineer."

In accordance with the general view that the time is ripe for more extensive propaganda, the Council have expressed their approval of the proposed steps for extending its official organ, The Illuminating Engineer. Up to the present the journal has served to put on record the work of the Society, but it is suggested that its field of usefulness would now be much increased if it could be rendered somewhat more popular in treatment, so as to appeal to a larger circle of readers. It is therefore proposed that, whilst continuing to present the accounts of the work of the Society, the journal should be increased in size; sections dealing with practical problems in a more readable manner being added. Arrangements in this direction are now being made.

International Developments.

Illuminating Engineering continues to receive much attention abroad. At the annual Convention of the American Illuminating Engineering Society in September last a series of interesting papers was read, and the societies in

Germany and Japan appear to be doing useful work. A further development of interest was the formation, on April 8th, of an Illuminating Engineering Society in Austria, and no doubt in course of time similar societies will be formed in other countries. Meantime there are other opportunities of arousing interest abroad, and it is to be hoped that the meeting of the International Illumination Commission in Geneva during July will lead to the presentation of papers of interest from this standpoint. Industrial lighting, in particular, is becoming a subject of international interest. A paper by the hon. Secretary is to be presented at the International Congress of the Royal Institute of Public Health in Bordeaux during June 4th–9th. Reports on this subject are also to be presented at the First International Meeting for the Study of Problems of Industrial Hygiene in Geneva in July. In addition the International Labour Office of the League of Nations in Geneva has taken a keen interest in this subject and their comprehensive report, issued in the autumn of last year, has now been published also in English.

FUTURE PROSPECTS OF THE SOCIETY.

The past Session has thus served to show the vitality of the movement and the constant tendency towards development on wider lines. But, as mentioned in previous annual reports, it is becoming increasingly clear that in order to take full advantage of the opportunities presented, a considerably higher revenue must be obtained—either by increase in membership or in the form of contributions from bodies that benefit from the work on which the Society is engaged.

The Council are now preparing the programme of papers for the next Session, and invite suggestions from members who are prepared to read papers.

LEON GASTER, *Hon. Secretary.*

THE ILLUMINATING ENGINEERING INSTITUTE AT KARLSRUHE.

It may be recalled that in 1921, simultaneously with the formation of a local Illuminating Engineering Society in Karlsruhe, the organisation and equipment of a special Institute for carrying out photometric tests ("Lichttechnische Institut") was commenced. A description of the Institute was recently given by Dr. J. Teichmüller in the *Zeitschrift für technische Physik.*

There are a number of laboratories with black walls, apparently well equipped with testing apparatus, including several photometric benches, integrating spheres, and apparatus for obtaining polar curves. Another room, with white walls, is set apart for tests of illumination when the room is lighted by various methods and by different lighting units. There is also a species of showroom where a variety of types of lamps and fittings can be seen. A number of rooms are set apart for the use of the Director and his staff, and for administrative purposes.

Perhaps the most interesting feature of the arrangements is the design of a special observatory tower, with a chamber at the top completely enclosed by glass. This serves for tests of sky-brightness and daylight illumination and also for experiments with searchlights. The Institute is well supplied with electrical plant enabling all desirable pressures, both alternating and direct, to be obtained for testing purposes.

The development and equipment of the Institute was rendered possible chiefly by the support given by the German lighting industry. The Institute works in close relation with the "Lichttechnische Gesellschaft" formed in Karlsruhe early in 1921, and can supplement the work of the Society both by carrying out experiments it desires and by extending the circle of those interested in illumination.

It is to be hoped that in the future a special building devoted exclusively to photometric work and experiments on illumination will be available in this country, where at present such investigations have to be undertaken by institutions already fully occupied by other duties.

SOME PROBLEMS IN THE DAYLIGHT LIGHTING OF TEXTILE FACTORIES.

Contributions to the Discussion of the paper on the above subject presented by Mr. P. J. Waldram before the Illuminating Engineering Society on April 28th, 1924.*

MR. D. R. WILSON (*communicated*) :— The author of this paper is to be congratulated on his interesting handling of a very wide subject ; few industries within my knowledge contain occupations with more varied lighting requirements than the textile.

I am interested to see that the author calls attention to one very important factor in industrial lighting which is sometimes overlooked, and points out that the spinning and weaving processes differ in their lighting requirements in that the former involve work on a vertical plane, the latter work in a horizontal plane.

Work on a strictly vertical plane is rare in industry apart from certain machine processes, the only ones that I can think of occur in the textile trade. Weaving, of course, is a true example of " horizontal " work ; we are sometimes, however, apt to assume that any work carried out on a horizontal surface (such as a bench) is work on a horizontal plane. This is often not the case, for the article may be three dimensional, and the most important surface may not be the horizontal one. It is indeed not always easy without close observation to determine the inclination of the predominant working surface. I venture to emphasise this point, as it is clearly of great importance in illuminating engineering, and cases have been met by me where the plane of work has been wrongly estimated.

Apart from the matter of the plane of work, it seems to me that spinning and weaving processes can be differentiated in another way, namely, as regards the visual demands made on the operatives. In the former, the operative acts primarily as a detector of faults, and when once the faults have been located, the operation is completed entirely by the sense of touch. For the purpose of detection, the operative relies on the contrast between the individual yarns and the darker background of the spinning frames, etc., and sufficient of this is generally obtained with a moderate illumination, when, as is usual, the yarns are undyed ; where dyed yarns are used, the illumination should be correspondingly higher.

In weaving, " detection " is also necessary, but not only is this more difficult because the yarns in the warp are set much closer together, but when the broken ends are found they have to be pieced together with special care. Further phenomena known as " smashes " and " floats " sometimes occur, and very close and detailed discrimination is needed to put these right.

For weaving, then, both contrast and a good illumination is desirable. The former is generally left to the warps as viewed against the floor ; where, however, very fine and dark coloured warps are used (as sometimes in silk weaving) the contrast is often artificially increased by whitening the part of the floor directly under the loom.

As regards illumination the amount provided by artificial means in the ordinary type of weaving shed is of the order of 1 to 2 foot-candles, and this is often described as adequate. This, however, has always seemed to me to be on the very low side, and I have sometimes wondered whether an experiment with a much higher illumination would not yield some surprisingly interesting results. At any rate it has been shown by investigators to the Industrial Fatigue Research Board that in fine weaving

* *See* ILLUM. ENG., May, 1924, pp. 79–87.

production falls by about 10 per cent. with artificial light of this order of illumination, as compared with daylight.

Another matter in the textile trades which seems to call for investigation is the proper lighting of jacquard looms, which, as the author implies, offers special difficulties of its own.

There is one other point in the paper to which I should like to refer, and that is to the limitation of window space in spinning mills, on account of its influence on the inside temperature. I remember some years ago going over some newly constructed mills in Lancashire with very extensive windows and being then told that these windows were as large as structural exigencies would allow. The author speaks, of course, with much later knowledge of the industry, and I should be interested to learn whether large windows of this type have now been given up for the reason stated.

Mr. A. K. TAYLOR (*communicated*) :— With reference to the lighting of Ring Spinning Rooms, and Fig. 6 in the paper, it would be useful to know if the values of vertical and horizontal daylight factor (given in the curves A and B) were obtained from observations or if they were calculated. Assuming a room 110 feet wide with windows at each side 7 feet wide by 9 feet high, the theoretical vertical daylight factor at 6 feet below the top of the window is :—

> 20·4 per cent. at 10 feet from window, and ·88 per cent. at 55 feet from window ;

while the corresponding horizontal factors are :—

> 5·55 per cent. and ·167 per cent.

Since good lighting is especially necessary where a thread has to be repaired it would appear that the horizontal illumination from both sides would be available, in which case the daylight factor in the centre would be doubled. The horizontal factor will then be 0·33 per cent.

The ratio of the vertical factors at 10 and 55 feet is 23 and the corresponding ratio of the horizontal factor is 16·7, so that the variation factor is better for the horizontal than for the vertical illumination, though the actual illumination is roughly three times as great in the vertical plane as in the horizontal plane.

Mr. SYDNEY STOTT of Oldham—one of the best known designers of textile mills in this country and abroad—has sent the following contribution to the discussion :—

It seems to me that there are two chief points which require bearing in mind : (1) the amount of daylight which is permitted to enter a room ; (2) how can the permitted amount be augmented and made more efficient.

Regarding (1) it is obvious that the size of the window restricts the amount of permitted daylight, and the height of the rooms chiefly restricts the windows in the most valuable direction, *i.e.*, towards the light. It has been found, however, that there must be an economical limit to the heights of the rooms, as the taller they are the more costly it will be to erect a mill and heat it ; and about 13 ft. 6 in. floor to ceiling is probably the best height for mule and ring rooms. Card Rooms have to be taller (about 17 ft. 6 in.) as Ground Floor sheds are often built round the main block and light obtained for the main block over or through the sheds. The window heads are put in at the same level as the ceiling so that no light is lost, and the ceiling should be as flat as possible. The height of the sills above the floor level generally is about 3 ft. 6 in. and I do not think anything would be gained by making them higher.

My practice is now to make one large window to each bay, though this used to be divided into three with two small intermediate piers. With this system no difficulty is experienced as regards the lighting in the centre of a modern mule room with a width of 136 feet, and very good lighting is achieved in a ring room, which for two rows of frames is about 20 feet less in width.

No excrescences, such as hoists, stairs, etc., must be allowed to interfere with this side light, and these are now placed invariably at the ends where the light is of little utility (except at the mule headstocks) owing to the high creels on the machines.

[Regarding (2) Mr. Stott forwards a sketch (not reproduced) showing windows divided vertically into three equal portions, the lower portion is glazed with ¼ in. rolled peats glass, the middle third with 26-oz. glass, and the top with refrax glazing.]

The refrax glazing throws the light well into the centre of the room and is undoubtedly a great boon, but requires frequent cleaning, which I am afraid is often neglected.

The only other augmentation is lime-washing the interior walls and the ceiling, and this makes a wonderful difference.

A north-light roof is always necessary for weaving, and if possible it should be adopted for the sinding and beaming processes. In the old time weaving sheds the looms were very often placed parallel to the run of the lights, which is obviously wrong. Nowadays the loom lay-out is the first procedure and the planning of the shed must conform thereto, the lights always being at right angles to the looms, so that the weaver gets every advantage. The angle of the glass is invariably placed at 60 degrees from the horizontal, but as one gets nearer to the equator it must, of course, be brought more vertical so as to exclude the sun. My experience tells me that there should be, again, as flat a ceiling as possible under the slated portion, and for this purpose I use asbestos sheets which lend themselves to limewashing very well, and again we are assisted by reflected light. Obstructions in the roof span should be avoided and the glazing bars should support the ridge and the spars be strong enough to span from ridge to valley or gutter beam, thus avoiding steel principals to support the ridge.

Mr. P. J. WALDRAM (*in reply*):—Mr. D. R. Wilson's communication emphasises the need for further investigation. Artificial illumination of the order of 1 to 2 foot-candles on weaving frames is, I know, by no means uncommon, but one would certainly expect that real comparative tests carried over sufficiently long periods would reveal such a monetary advantage in better artificial lighting as would secure its speedy and wide-spread adoption. The paper draws attention to the diversity of opinion in Lancashire as to the maximum size of window which is possible without giving rise to serious temperature troubles.

In reply to Mr. A. K. Taylor's communication the curves in Fig. 7 were all calculated. They were taken at a working plane 9 ft. 0 in. below the window head, viz.: 3 ft. above floor level. The working plane taken by Mr. Taylor of 6 ft. below the window head, viz.: 6 ft. above the floor, would appear to be too high. The light from both sides was added together for all points on the curves.

Mr. Taylor appears to have calculated the variation factors on this plane by contrasting the light at 10 ft. and 55 ft. from the window. But in one case he takes the light at 55 ft. from one side only, and in the other from both sides.

The values should apparently be :—

For light on a vertical plane,
$20{\cdot}4 \div 1{\cdot}66 = 12{\cdot}3$.

For light on a horizontal plane,
$5{\cdot}5 \div 33 = 16{\cdot}6$.

This is slightly better for the vertical than the horizontal.

The fact that so experienced a designer as Mr. Stott can recommend such a generous window space is significant and valuable. If the floor is 13 ft. 6 in. in the clear and the sill 3 ft 6 in. high the window space would apparently be 10 ft. high and 9 ft. 6 in. wide. This would give 95 sq. ft. of window to 748 sq. ft. of floor or about 12·6 per cent. This is very considerably in excess of the older practice; and it would appear to be obvious that the limits set by older authorities, often very emphatically, were mistaken.

THE ILLUMINATION OF FACTORIES.

A PAPER on the above subject by Mr. L. Gaster was presented at the Congress of the Royal Institute of Public Health, held in Bordeaux during June 4th to 9th, 1924.

After dwelling briefly on the advantages of good industrial lighting, Mr. Gaster referred to the expectation that a clause requiring good lighting would be included in the next Factory Act. He recalled that even before the work of the Home Office Departmental Committee on Lighting in Factories and Workshops commenced, there was in existence legislation requiring adequate lighting in the case of certain industries, *e.g.*, those involving the handling of poisonous materials. Similarly in industries concerned with the preparation of foodstuffs good lighting is clearly desirable in the interests of health.

Reference was next made to the most recent recommendations of the Home Office Committee, and in particular the policy pursued in regard to intensities of illumination for various processes, which should be settled by consultation with the industries concerned. A clear distinction should be drawn between minimum values to be legally enforced and values desirable in good practice. It should be possible to take action if lighting conditions are prejudicial to health and safety, but when higher illuminations are desirable in the interests of productive efficiency one can only make recommendations. This point is clearly recognised in the latest code on industrial lighting in the United States—that adopted by the State of Wisconsin.

The paper showed how bad lighting may be responsible for industrial fatigue, and how the desirable illumination is influenced by many factors, for example, the reflecting power of the material. However, it should be clearly understood that the mere provision of a high illumination alone is not enough. Attention should also be given to such points as elimination of glare and troublesome shadows. The whole question of the effect of light on the accuracy and quickness with which operations can be carried out is well worthy of study by the physiologist and psychologist.

Dealing with daylight illumination the author summarised some of the important work recently done on access of light into buildings and pointed out the value of study of natural lighting in suggesting desirable features in artificial illumination. It had been suggested that possibly one's judgment of what constituted "bright" lighting might be affected by climatic conditions, *i.e.*, that people who lived in countries where there was continual bright sunlight might have a higher standard than those dwelling in northern latitudes, where the sun is frequently obscured by clouds.

In the final section of the paper Mr. Gaster referred to international developments, illustrated by the special interest being taken in industrial lighting by the International Labour Bureau of the League of Nations, and the forthcoming International Congress on Industrial Hygiene, to be held in Geneva in July. He recalled previous work done in the field of industrial lighting by French committees. It was gratifying to find, as a result of conversations with French experts, that the general principles in regard to legislation followed in England are also endorsed by leading authorities in France. Such co-operation was of material help in paving the way for international agreement on this important subject.

ILLUMINATION AT THE WORLD POWER CONFERENCE.

At the sectional meeting of the World Power Conference, held at the British Empire Exhibition on July 4th, 1924, three papers by Mr. J. W. T. Walsh, Mr. L. Gaster and Mr. C. W. Sully were presented dealing with various aspects of illumination.

International Co-ordination in Illumination.

Mr. J. W. T. Walsh in his contribution on "International Co-ordination in Illumination" recalled the origin of the International Commission on Illumination which was formed immediately prior to the war to assume, on a broader basis, the functions of the International Photometric Commission created in 1900. After explaining the constitution of the Commission Mr. Walsh gave a sketch of its work, referring first to the problem of the standard of light and the steps leading to agreement on the "international candle." Other recent investigations have been concerned with photometric definitions, lighting legislation and automobile headlights, and international committees have been formed for the study of these subjects.

In conclusion the author pointed out that the Commission is still only in the early stages of its existence. The attainment of standardisation and international agreement cannot be forced and can only be attained slowly. Meantime the Commission affords an effective opportunity for the interchange of knowledge and experience gained in different countries.

National and International Aspects of Illuminating Engineering.

The paper by Mr. L. Gaster on this subject supplemented that by Mr. Walsh, tracing the growth of the illuminating engineering movement in this country, and reviewing some of the most important problems with which it is concerned. After summarising investigations on the lighting of schools and libraries, the author pointed out the importance of good public lighting in the interests of safety of traffic, quoting figures to show the great increase in the volume of motor traffic during recent years, and the progressive increase in the number of street accidents—a substantial proportion of which are believed to be due to inadequate lighting. The provision of adequate street lighting is a matter of interest to London as a whole and should be reviewed by a suitably constituted central authority. Much might also be done to improve the lighting of provincial cities, and important inter-connecting routes carrying heavy traffic.

The author next gave a brief survey of the contents of reports issued by the Home Office Departmental Committee on Lighting in Factories and Workshops, and of recent researches indicating the relation between miner's nystagmus and inadequate lighting in mines. There were also many outstanding points of importance in connection with the lighting of docks and railways.

Mr. Gaster explained the functions of the various bodies working in co-operation with the Illuminating Engineering Society, such as the National Illumination Committee, the National Physical Laboratory, the Committee on Standardisation working under the B.E.S.A., and the Committee on Illumination under the Department for Scientific and Industrial Research. The work was too vast to be dealt with by the Illuminating Engineering Society alone and this society acted as a "liaison officer"—a cementing force.

This co-operation in national aspects of illumination is paralleled in international affairs. The formation of the International Illumination Commission, with national committees in all the chief countries, enabled many problems of general interest to be periodically reviewed, and the forthcoming meeting in Geneva was awaited with great interest. At the Conference on Industrial Hygiene also to be held in Geneva during July, the subject of industrial lighting would receive special attention, and this subject

was also being studied by the International Labour Bureau of the League of Nations. There were now also Illuminating Engineering Societies in the United States, Germany, Japan and Austria, and the movement was developing in all parts of the world. This country might claim to have taken a leading part in the movement but efforts must be made to maintain the position acquired.

In all this work the Illuminating Engineering Society is acting as the guardian of public interests in matters of illumination, and its work is also of direct interest not only to makers of lamps and lighting appliances but to the whole electrical industry. Stimulation of interests in proper methods of illumination naturally brings about increased consumption of electricity by which supply companies benefit. Improved lighting installations provide work for makers of cables, switchgear and all forms of electrical accessories. Growth in current consumption, again, ultimately benefits makers of generating plant. Illuminating Engineering, a subject of national and international interest, has thus a special claim on the electrical industry as an important agent in its further progress.

Progress in Electrical Illumination.

The paper by Mr. C. W. Sully on the above subject covered very wide ground and contained a considerable amount of statistical data. In the introduction the output in electrical energy and the number of lamps sold per annum in various countries was given. The United States heads the list in both cases, 6,870 million units being generated during 1922, and 205 millions of lamps (approximately 1·74 per capita) sold. It is interesting to note that Japan comes second on the list as regards electrical energy generated, Germany being third and the United Kingdom fourth. In regard to electric lamps sold the United Kingdom, with 20 millions, comes sixth amongst the countries mentioned, if one works on the basis of lamps sold per capita (0·42). Italy and Hungary have very similar figures, Germany (0·88) comes third. Switzerland (1·62 per capita) alone approaches the United States. It is, however, worth noting that the amount of light used in this country appears to be steadily increasing. For the three years 1912, 1917 and 1922 the average wattages of lamps sold were 36·1, 46·8, and 57·4. This, it is pointed out, clearly indicates the public demand for a higher standard of illumination.

Section I of the paper was devoted to the evolution of the electric incandescent lamp, the steps from the first platinum filament lamp to the gasfilled tungsten lamp being set out in order of date. The average efficiency of the gasfilled lamp is given as 12·5 lumens per watt as compared with 3·3 lumens per watt in the case of carbon. Put in another way the total cost per 1,000 c.p.-hours is reduced from 22·8d. to 6d. England's electric lighting bill is about £18,000,000. If the lamps in use 20 years ago had not been improved the cost (for the same amount of light) would have been £72,000,000.

In the chapter on the economics of electric light the author pointed out the great influence of variation in voltage on the candlepower emitted. In a typical case it is shown that when a lamp is operated 10 per cent. below its proper voltage the output of light is reduced by 33 per cent.

Turning next to principles of illumination Mr. Sully presents diagrams, showing how acuteness of vision and speed of reading are improved by increased illumination. According to the curve presented speed of reading was still increasing when the illumination was carried up to nearly 30 foot-candles; the greatest acceleration, however, is to be observed in the range from 0 to 12 foot-candles. Other curves illustrate how power of sustained vision and capacity for sustained vision are affected. In both cases the benefit of improved illumination is shown, an interesting feature being the apparent demand for more light on the part of an astigmatic eye as compared with a normal one.

Mr. Sully next emphasised the importance of well designed fittings, showing a variety of shapes ranked in regard to efficiency, glare, shadows and maintenance. The importance of using only lamps intended for specific reflectors was

emphasised. In an extreme case it was found that substituting a 200-watt lamp for a 100-watt one, in a fitting designed for the latter, actually led to less light being received on the working plane.

Next, such problems as the lighting of houses, offices, factories, etc., were briefly reviewed. The cost of equipping a house with electric light comes to only 4-5 per cent. of the total investment upon it. Hence the expense needed to secure comfortable lighting conditions is not a serious item. The best methods of treating halls, drawing rooms, dining rooms, etc., were briefly dealt with. In offices 3 foot-candles is a usual figure, but extremes on either side are met. In new installations a higher intensity up to 10 foot-candles and never less than 5 is recommended. Effects of glare are of great importance in office lighting and should be carefully guarded against. In industrial lighting the introduction of units up to 1,000 and 1,500 watts has led to the general adoption of overhead general lighting and local lighting is now rarely necessary. Dealing with the benefits of good lighting the author mentioned the familiar data contained in the Home Office Departmental Committee's report showing the direct relation between illumination and accident-rate, especially in the case of "persons falling." A list of suggested values of illumination for different classes of workrooms, ranging from 0·5 to 10 foot-candles according to requirements, is given, but the tendency is towards higher values.

Instances of the influence of better lighting leading to improved production are quoted. Researches by the Industrial Fatigue Research Board showed that in the textile (silk and cotton weaving) industry production by artificial light was in general 10 per cent. less than by daylight, a result which may be explained largely by the inadequate and irregular artificial lighting at present met with in many mills. Confirmatory tests in the United States also illustrate the effect of improved lighting in increasing output. The author quotes several examples. One of the most striking cases is illustrated by a chart relating intensity of illumination to the average number of pieces inspected per person per hour. The amount of work done is shown to increase always as the illumination rises and diminish when the illumination is reduced.

Other lighting problems such as those involved in streets, shop-windows, advertising, etc., are also considered. Attention is drawn to the effect of inadequate lighting in increasing the number of accidents in streets and on railways. Illustrations of effective spectacular lighting are shown and reference is made to other applications of electric light, *e.g.*, in the form of "artificial daylight" and in connection with projector lamps of various kinds.

In conclusion the author attempts a rough estimate of the value of the business awaiting the electrical industry in connection with the lighting of factories, offices, shops, public buildings and the home. Adding these figures together he arrives at the conclusion that £47,975,000 might be profitably expended in re-equipping such buildings to modern recommendations, and £343,340,000 in the equipment of unwired buildings—a total of £391,315,000.

These figures take no account of the annual revenue to be derived from the sale of energy or of the business to be done in providing additional generating equipment, switchgear, cables, and the numerous mechanical devices such as automatic stokers, coal conveyors, etc., which form an integral part of the modern generating station.

The paper concluded as follows:—

"To sum up, the intensive development of electric lighting, which would be of inestimable value to the general public, would at the same time stimulate trade in all directions. The first step which is necessary in order to set in motion a scheme of development is the education of the public. The achievements of the engineer must be presented to the consumer in the most speedy and effective way. Well organised and intensive campaigns through the proper channels should be conducted in order to induce existing electric light users to improve their installations. The ideas of prospective consumers should be moulded so that new installations will be equipped in accordance with modern practice,

We attach great importance to the latter category because the practice adopted for the majority of new electric light installations is little in advance of the methods employed twenty years ago.

"In our opinion the quickest and most convincing means of education in illumination matters is actual demonstration of lighting effects. Descriptions of lighting effects are seldom convincing; the "atmosphere" created by adequate well-diffused illumination must be experienced in order to be appreciated. Fittings showrooms, in which a mass of ornamental metal is submitted for inspection, help little in improving standards of illumination. Accordingly we suggest the establishment throughout the country of well-equipped demonstration rooms, where correct principles of electrical illumination, supported by convincing data, can be presented to selected classified light users. Such an enterprise must of necessity be organised by electrical retailers and supply undertakings, since they represent the only sections of the electrical industry in direct contact with the public. In order to encourage this essential process of public education the Electric Lamp Manufacturers Association has acquired premises in London fully equipped for the demonstration of various forms of illumination, and for illustrating the benefits of improved methods and higher standards in the art of lighting."

"In conclusion we maintain that good lighting implies much more than mere utility or decorative effect. It is a matter of national importance. It has direct bearing on the safety, well-being and temper of the people. On the domestic side it means brighter and more cheerful homes, increasing the comfort and happiness of social and family life. On the industrial side it means greater safety, increased production, and less strain upon the operatives. On the public side is increased amenities of life in the cities, towns and villages, rendering our streets safer and more effective, and combating the depressing effect of our winter climate. The movement towards more and better light is, therefore, one to which statesmen, public health authorities, industrial and social reformers, and all others concerned with the betterment of conditions of life should give sympathetic study and every possible encouragement."

PRESENT PRACTICE IN MOTOR BUS LIGHTING.

A PAPER recently read before the Illuminating Engineering Society (U.S.A.) by Messrs. L. C. Porter and A. C. Roy, discusses present practice in motor bus lighting in the United States and possibilities of improvement. It is estimated that in that country there are to-day about 40,000 buses in use. At present there is little legislation on the lighting of them, though most cities having control of motor bus traffic specify that there should be "adequate lighting" or that the buses "shall be well lighted . . ."

There is need for a clearer understanding as to what is meant by good lighting. The authors accordingly undertook a survey of conditions in the City of Newark, a study being made of fifty-one buses of different types. It appears that the average bus contained six enclosing-dome fixtures, usually badly in need of cleaning and inefficient. In many cases one or more lights were out owing to lamps being missing or burnt out. Other defects included wire of size too small to carry the lighting load without excessive voltage drop, and batteries of inadequate capacity.

It was found that 73 per cent. of the buses tested had 6-8-volt installations, and the remaining 27 per cent. 12-16-volt systems. The chief advantage of the 12-16-volt system is the smaller voltage drop. The experiment was made of introducing successively lamps of increasing wattage in existing sockets and measuring the illumination in each case. In many cases *increasing* the size or candlepower of the lamps used actually *decreased* the resultant illumination, owing to the heavier voltage drop arising from the greater current taken by the larger lamps. On most of the buses it was difficult to determine definitely the capacity of the batteries, but in many cases the size was obviously inadequate. The majority of the buses were not equipped with generators, so

that the load was taken entirely by the batteries and drivers were accordingly very sparing of the hours burned and number of lamps used. In a number of cases it was found that the conditions necessary for efficient wiring were not clearly understood.

With a view to improving the present inadequate lighting, the authors make the following suggestions :—

(1) Adequate wiring should be provided, preferably No. 10, and never less than No. 12 wire being used.

(2) Generators of ample capacity should be used. The 300-watt types appear to be the largest which will fit under the hood of the present bus. In the design of future large buses, room should be provided for the 600-watt generator. Storage batteries of ample capacity should be used in all cases.

(3) Gasfilled lamps, preferably of the 21 c.p. size with enamelled bulbs, should be used. The 21 c.p. size is recommended.

(4) Reflectors are to be preferred to any type of bowl fixture, as the latter is usually inefficient and apt to become dirty. Reflectors should be selected to distribute the light efficiently on the level of books or papers read by passengers. Those having a 60° distribution, mounted on the ceiling, located 6 in. to 1 ft. from the sides of the bus, tilted inwards about 5° and spaced 3 ft. apart, answer well. Properly selected and located reflectors will distribute usefully most of the light which would otherwise pass out of the glass windows. The reflectors should be of heavy glass and held rigidly.

(5) Eight reflector-units, equipped with 21 c.p. lamps, four on each side, spaced 3 ft. apart, should be used for a 25 passenger bus. This arrangement should give an initial illumination of eight foot-candles on the reading plane. If lamps are wired on alternate circuits, the lamps on each circuit should be staggered from one side of the bus to the other to distribute the lighted units evenly.

(6) Ceilings should be enamelled white as this aids considerably in the distribution of light in the bus and gives a more cheerful appearance.

ARTIFICIAL DAYLIGHT.

An article recently contributed by Dr. L. C. Martin to *Nature* reviews existing methods of producing artificial daylight. The Moore vacuum tube, one of the first sources devised to furnish light resembling daylight in colour-value, can, it is suggested, only be regarded as an approximation as the spectrum, being evolved by luminescence of a gaseous conductor, consists of bands and is not entirely continuous.

The familiar methods of filtering light from a gasfilled lamp through special tinted glass, or correcting it by reflection from a specially coloured surface (as in the Sheringham Daylight) are described. With a gasfilled lamp the luminous efficiency of accurately corrected units is probably of the order of 15 per cent., though much depends on the design of the reflector which, by aiding concentration of light, may counteract the unavoidable disadvantage of loss of light in the filter.

In the case of lamps with bulbs either composed of blue glass or coated with a gelatin filter the correction is not nearly so thorough and, therefore, the luminous efficiency is more favourable, perhaps up to 60 per cent. or so. These less fully corrected sources are useful for the lighting of shop-windows of florists, drapers, etc., but for accurate colour matching tests a higher order of efficiency is necessary. So far as can be judged, the author thinks artificial daylight has proved quite satisfactory for many industrial processes involving careful colour matching, provided sufficient care is taken in selecting a lamp suitable for the work in hand. Amongst materials which are commonly graded by colour, tea, leather, tobacco, seeds and flour are mentioned. Artificial daylight has also proved of considerable value in aiding many careful chemical estimations depending on a colour change.

In view of the improvement in lighting generally it is remarked as singular that artificial daylight has not attracted more attention from commercial firms in this country. In 1920, there were 15,000 fully corrected artificial daylight lamps in use in the United States and the demand was then rapidly growing.

THE LIGHTING OF THE CARPENTER'S SHOP.

IN a recent article in the *Illustrated Carpenter and Builder*, the author reviews recent developments in industrial lighting, dealing particularly with the lighting of carpenters' shops. Reference is made to the prospect of provisions for adequate lighting in the next Factory Act, a step which should be welcomed by employers and workers alike and the contents of recent reports of the Home Office Departmental Committee on Lighting in Factories and Workshops are summarised.

Importance is to be attached to good access of daylight. Light entering the windows high up is of special value, illuminating the back part of the room which might otherwise receive very little light. Rooms should preferably be lighted from both sides. If illumination is received from one side only the depth should not exceed twice the window height; whereas with windows on both sides a depth of four times the window height is permissible.

As regards artificial lighting fundamental requirements are: (A) sufficient illumination; (B) reasonably uniform illumination over the working area; (C) absence of dazzle or glare in the eyes of operators; (D) absence of inconvenient shadows on the work; and (E) constancy of light (absence of flicker).

A plane 2½ to 3 feet above the floor may conveniently be taken as the "working level." But a carpenter's shop is a good instance of those cases where good illumination of vertical surfaces is quite as important as the illumination on a horizontal plane. Operations with a saw or chisel frequently involve close inspection of vertical surfaces and inconvenient shadows from the edges of the tool have to be guarded against. Hence it may sometimes be necessary to supplement the general diffused lighting by special local lights. Conditions of shadow are particularly important in the case of chisel operations, in cutting grooves, recesses, etc. Light walls and ceilings are of great benefit in softening shadows and one usually finds that carpenters' shops are finished with light material. Circular saws need to be lighted with extreme care. It is very difficult to guard them in such a way that serious danger to the operator is eliminated, and sharp shadows thrown by the cutting edge are liable to lead both to mistakes in workmanship and to accidents to workmen. Hence the position of sources in the immediate vicinity of circular saws should be carefully selected.

The conditions favourable to elimination of glare are explained in the Home Office Committee's Second Interim Report. Importance is to be attached to the use of somewhat deep reflectors, with the filament well above the plane of the rim of the reflector, and an angle of "cut off" of 30°. If shallow reflectors, allowing the filament to be seen, are used, they should be placed high up in the room, well out of the range of vision of workers.

As regards intensity of illumination it is pointed out that much depends on the nature of the material and the accuracy of the work. The fact that carpenters' shops are usually filled mainly with light material causes them to appear brightly lighted with a comparatively low illumination. It is suggested that an illumination of *not less than* 3-4 foot-candles will answer most requirements; but if work is done with dark materials, oak or walnut, this may need to be increased. A shop in which painting is done may also require higher illumination, and here strong illumination of vertical surfaces may be particularly important. In this department there are also opportunities for the use of "artificial daylight," enabling the appearance of colours by daylight to be correctly judged.

Finally there is the important question of maintenance of lighting fittings. In view of the special importance of eliminating troublesome shadows in a carpenter's shop there is much to be said in favour of the use of semi-indirect lighting units. Unfortunately such units, unless carefully protected, are liable to become dusty very quickly in a carpenter's shop, and the resultant loss in illumination may amount to 30 or even 50 per cent. of light within quite a short period. Hence lighting units which are so far as possible "dust-proof" should be selected, and these should be examined and, if necessary, cleaned at regular intervals.

GROWING GRASS BY ARTIFICIAL LIGHT.

ATTENTION was drawn in our last issue* to recent American experiments on the use of light as an aid to horticulture. It is interesting to note that, according to *Golf Illustrated*, the light from gas-filled lamps has proved of value in accelerating the growth of grass.

The experiments were made on the course of the Jumping Brook Golf Club, New Jersey. A clay-gravel site was prepared and top soil from another portion of the land added. This was sown with grass-seed early in June, and over a portion of the area twenty-four 1,000-watt gasfilled lamps, each equipped with a special concentrating reflector, were erected.

The lights were put into operation on June 6th and turned on for the next 21 nights. Although the weather was considered unfavourable to germination, the first seeds in the lighted area came through five days after planting, whilst nothing came through on the unlighted portion until two days later. At the end of three weeks the grass under the electric lights had attained a general growth of nearly four inches, while on the portions of the green outside the lamps there was a growth of only about one inch.

Experts are stated to agree that the use of artificial light in this way saves at least 40 per cent. of the time between planting and cutting the average green, and that after cutting it thickens the growth. In this case the ground treated was ready for use two months after sowing.

The idea also deserves consideration in connection with tennis lawns where quick growth of grass is often important. It is to be noted, however, that an installation such as that described would consume 24 units an hour, costing, at 6d. a unit, 12s. an hour, and it is doubtful whether the urgency of securing rapid growth of grass would often justify this expenditure.

* ILLUM. ENG., May, 1924, p. 64.

SCHOOL LIGHTING IN THE TRANSVAAL.

OUR attention has been drawn to a very interesting note occurring in Dr. Louis Leipoldt's Report to the Transvaal Education Department (1922). Opinion in England is strongly in favour of the view that inadequate lighting is a contributory cause of eyestrain in schools, and much work has been done in the direction of specifying minimum access of daylight. (A very full discussion on this point, for instance, is to be found in the report of the Joint Committee of the Illuminating Engineering Society on Natural School Lighting issued in 1914.)

But consideration must be paid to climatic conditions. Dr. Leipoldt points out that the intense glare of Transvaal sunlight is something very different from the diffused daylight of northern latitudes. Indeed, he is disposed to think that excessive light, with its resultant glare, cannot be acquitted of the charge of causing at least a high percentage of visual defects. Experimental tests with the lumeter have shown that most of the Johannesburg and Pretoria classrooms have from 10 to 200 per cent. more direct light than the average London classroom. Even a badly lit classroom, such as that in the old Eendracht School of Pretoria, was found, on testing with the lumeter, to have actually more light than a well-lit London classroom.

Only by means of careful and long-continued lumeter readings, he remarks, can the standard of illumination in Transvaal classrooms be determined; there are no scientific data justifying the conclusion that the amount of illumination necessary in a European classroom is the same as that required in South Africa. Whereas, in England, stress is commonly laid on the desirability of colouring walls a light tint, in the Roodeport Central School, where the percentage of visual defects due to glare was excessive, trials have been made with a material for walls having a high absorption, and apparently with good results, though confirmatory data are needed.

ILLUMINATION BY GAS.*

By J. S. G. THOMAS and D. CHANDLER
(*South Metropolitan Gas Company*).

THE above paper was not read in Section L (Power for Illumination) of the World Power Conference, but in the Gas and Fuel Section. The early history of gas lighting was summarised—the invention of Murdoch, the gift of the Bunsen burner to the gas industry, and the discovery by Welsbach of the incandescent mantle. Various difficulties, such as uncertain quality of gas, variable pressure and badly designed burners have proved detrimental to gas lighting in the past. But at the present time artistically-designed gas lighting appliances and fittings, capable of satisfying the demands of the most fastidious, are available. In this connection the author quoted from a paper read by Dr. Carpenter before the Institution of Gas Engineers in 1922, in which he referred to the use of shoddy burners, remarking: "The stability of the business of gas undertakings is seriously imperilled by the dissemination of such rubbish and the time has passed when it could be treated with indifference. But gas companies themselves send out thousands of appliances which they leave to their peripatetic fitters or even to the customers themselves to 'tune up' on the premises. Surely they should satisfy themselves that every appliance passing through their hands is of a kind properly to satisfy the requirements of the users." The Gas Regulation Act (1920) has done much to ensure gas of a declared standard of quality and assist the efficient operation of the gas-consuming appliances, and is believed to have had a most beneficial effect in stimulating the demand for gas lamps of all kind.

In order to illustrate the great growth in the volume of gas lighting and the improved efficiency the following figures, applying to the streets of South London, are given :—

Year.	Number of Public Lamps.	Gas consumed (Millions of cub. ft. per annum).	*Equivalent Candle-power.	Candle-hours per cub. ft. of gas consumed.
1899	20,998	478	280,000	2·5
1902	21,800	359	†1,270,000	14·0
1913	24,713	371·5	†1,700,000	19·0

Thus in 1902 the candlepower furnished had increased five-fold with an increase of only 4 per cent. in the number of lamps and a decrease of approximately 20 per cent. in the total annual consumption. Still greater economies would be achieved by the complete replacement of upright by inverted incandescent burners.

As an illustration of the march of progress the following figures are instructive :—

Type of Burner.	Efficiency (Candle-hours per therm).
Flat flame	360
Upright incandescent	2,700
Low pressure inverted incandescent	3,600
High pressure inverted incandescent	10,800

Turning to the important field of industrial lighting the authors emphasise the part played by efficient lighting, and the small proportion which the cost of lighting forms of the cost of production. Thus, if it is assumed that each worker is furnished with an inverted incandescent burner yielding 75 candles, the cost of installation, including piping, per point, lamp, silica globe and enamelled iron reflector amounts to £2 5s. 8d. Similarly, the total costs of operation and maintenance (interest on investment, depreciation, renewal of mantles) works out to £1 7s. per annum. If one assumes that the operator receives £3 a week, *i.e.*, 3,000 shillings per annum

* Abstract of a paper read before the Gas and Fuel Section of the World Power Conference.
† Based upon a lighting period of 4,200 hours per annum.

then the cost of operation of the lighting is met if the worker can save about 27/3,000 of his time, *i.e.*, four minutes per day of eight hours. Reference is made to the reports of the Home Office Departmental Committee on Lighting in Factories and Workshops. The recommendations in regard to the amount of illumination required for "fine" and "very fine" work, and the avoidance of glare are quoted. According to a table of intrinsic brilliancies presented, the brightness of the moon is about 2, and of the sky and the candle flame about 2·5 candles per sq. in. The brightness of the low pressure incandescent mantle is 40 candles per sq. in., and of the high pressure incandescent mantle 250 candles per sq. in.

The tendency during recent years has been to obtain sources of continually increasing candlepower, but this increase in efficiency is usually attended by greater brightness. However, the modern use of cluster superheated inverted burners enables the candlepower to be increased by adding to the number of mantles, and thus without any advance in brightness. Such cluster burners give from 5,000 to 6,000 candle-hours per therm, and there is the incidental advantage that the breaking of one mantle does not render the whole lighting unit ineffective. Moreover, the prejudicial effects of glare can be very readily met by proper methods of shading. Thus, the "Metro" No. 3 burner yields about 75 candles. In order to reduce the brightness to 5 candles per sq. in. it is only necessary to surround the mantle with a translucent globe having a projected area normal to the line of sight of 15 sq. in. Such a globe, with sides about 4 in. in length, is not inconveniently large, and the necessary degree of diffusion is provided by the use of fused silica glassware.

Apart from the actual brightness of light-sources it is desirable that the contrast between the source and surrounding should not be excessive. Weber suggested that this ratio of brightnesses should not exceed 100 to 1. An American Committee has found that ratios as high as 200 to 1 may be tolerated, but that the best effect is obtained if the diversity factor does not exceed 20.

DEFINITIONS RELATING TO SEARCHLIGHTS.

ACCORDING to *Licht und Lampe**, the following recommendations of terms used in defining the properties of searchlights have been proposed for adoption by the German Illuminating Engineering Society :—

(1) The properties of a searchlight are defined by the total flux of light emitted, the maximum candlepower, and the distribution of light.

(2) The magnification of a searchlight is the ratio of its maximum candlepower to its mean spherical candlepower.

(3) The distribution of light of a searchlight is defined in terms of the candlepower at various angles in the plane passing through the axis of the projector. The distribution should be plotted in rectangular co-ordinates, the middle rays in the respective angles being taken as abscissæ and the corresponding candlepowers as ordinates.

(4) The diffusion (Streuung) of a searchlight for distant operation is the angle within which the candlepower exceeds half the maximum candlepower ; for close operation it is the angle within which the candlepower exceeds one-tenth of the maximum candlepower.

(5) The stray light of a searchlight is to be indicated by the light distribution in a vertical plane through the axis of the projector.

(6) The utilisation factor (Ausnutzungsgrad) of the flux of light is the ratio of the flux received by the mirror to the complete flux emitted by the naked source.

(7) The efficiency of the mirror is the ratio of the total flux emitted by the searchlight to the total flux received by the mirror.

(8) The efficiency of the searchlight is the product of (6) and (7).

(9) The durability of the mirror is determined by the alteration in its efficiency during use.

(10) The ideal range is the distance in metres at which an illumination of 1 lux is produced by the maximum candlepower, atmospheric absorption being neglected.

(11) The practical range is obtained by multiplying (10) by a factor k, which is less than unity and depends on the atmospheric absorption.

* July 31st, 1924.

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED.

Michael and Will on the Law relating to Gas and Water. Vol. I.—Gas. Seventh Edition. By E. T. Villiers Bayly. (Butterworth and Co. 1924. pp. 509; Index 49. 50s. net.)

IN the preface it is stated that it is thirteen years since the last edition of this book appeared. In the meantime changes in the law relating to gas undertakings have been made. Part I. deals with General Gas Acts with Statutory Rules and Orders; Part II. with the Metropolis Gas Acts. In subsequent Miscellaneous Acts, such as the Public Health Act (1875), the Lighting and Watching Act (1833), the Borough Funds Acts of 1872, 1888 (Ireland) and 1903, the Public Authorities Protection Act (1893), etc., are summarised. There is an adequate index and the work should be of considerable value to those concerned with the legal aspects of gas undertakings.

Gas Regulation Act, 1920; *General Notification of the Gas Referees. (Price 1s. net.) Return relating to all authorised Gas Undertakings in Great Britain for* 1923. *Part I. 5s. net. (Obtainable from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.)*

WE record the receipt of these two official publications which, as usual, contain detailed information regarding gas undertakings. A modern development is the inclusion of particulars of calorific value, though we note that in some cases these are not yet available. Quantities of gas made and sold are now shown both in cubic feet and therms in cases where undertakings have been authorised to charge for heat units consumed. The total quantity of gas made during 1923 was 7,779,215,000 cubic feet in excess of the quantity made in 1922, and the number of consumers increased by 138,204, two-thirds of these being prepayment consumers.

Journal of the National Institute of Industrial Psychology. July, 1924.

THIS volume contains a record of speeches delivered at the Institute's Dinner. One of the most interesting is that delivered by Mr. C. T. Cramp, General Secretary of the National Union of Railwaymen, who emphasises the necessity for hygienic conditions, happiness of mind and satisfactory home life of employees, and points out that the work of the Institute is only beginning and is essentially experimental. Other contributions include: "The Group Mind in Trade Unionism," by C. Delisle Burns; "Industrial Psychology: Some Way of Increasing Output of Work," by Winifred C. Cullis; "The Selection of Engineering Apprentices," by Max Tagg; and "Recent Developments in Vocational Guidance," by G. H. Miles.

"Truth about Circulation." Issued by the Incorporated Society of British Advertisers, Ltd.

THIS booklet contains a report of the proceedings at a meeting held at the British Empire Exhibition on July 15th. There are many useful points raised in the discussion, especially the recognition that "net sales" are not sufficient and that due attention must be paid to the quality as well as the quantity of the circulation, in relation to the article advertised. This is naturally a point that appeals strongly to trade, technical and scientific publications.

Ernest Benn, Ltd. Forthcoming Publications.

IN the list of forthcoming publications by Ernest Benn, Ltd., we note: *Self-Instruction for Students in Gas Engineering* (Elementary), by "Mentor" (6th edition); *The Scientific Promotion of Gas Sales*, by Arthur Coe.

Another step is the issue of the "Electrician" series of *Specialist's Data Books*, under the general editorship of Mr. E. B. Wedmore. The first three volumes will cover Lighting, Traction and Power Distribution (Vol. I.); Manufacture Design and Laboratory Work (Vol. II.); and Telegraph, Telephone and Radio Engineering (Vol. III.).

Charles Letts's Engineering Diary.

WE understand that the 1925 issue of this *Diary*, written by Mr. J. E. Dodsworth is now in the press and will be published shortly by Messrs. Charles Letts, Ltd. The usual three sections are being retained: the diary proper (7 days to a page); the general business information section (32 pages); and the engineering section (48 pages). Some new features have been added.

DYNELEX, LIMITED.
Change of Address.

MESSRS. Dynelex, Ltd., Electrical Engineers and Contractors, are now carrying on business at their new address at 30, Percy Street, Tottenham Court Road, W.1.

TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we have extended the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

SIMPLEX INDUSTRIAL LIGHTING FITTINGS.

In the introduction to this catalogue it is remarked that "efficient illumination is now thoroughly recognised and appreciated as an exact science." Extracts are made from the recommendations of the Home Office Departmental Committee on Lighting in Factories and Workshops, and some hints on the planning of industrial lighting installations, accompanied by a list of recommended intensities of illumination for various purposes, are given.

The earlier portion of the booklet is devoted to illustrations of weatherproof lanterns for public lighting, etc., including types equipped with the special Holophane glassware designed to give uniform illumination. Later standard metal reflectors for industrial and general lighting, semi-indirect fittings, etc., are listed. A special section is devoted to indicator signs such as those used by railway companies, or for attachments to street lampposts, etc. Amongst the latter we notice a weatherproof device for exhibiting "Safety First" notices. This consists of a box-sign carrying the word "CAUTION" or any other desired indication, mounted immediately above the street lamp, and lighted by several supplementary incandescent lamps, to which access is afforded by a hinged side.

OSRAM LAMPS.

Several lists recently issued by the General Electric Co., Ltd., deal with the so-called "White Osram" lamp, the bulb of which is sprayed with a thin layer of unglazed china so that it appears uniformly illuminated all over, and the filament is indistinguishable. Such lamps are specially recommended in situations where freedom from glare is important. It is stated that the diffusing coating is unaffected by light, heat, water or acids and can be washed with soap and water when required; also that the loss of light through absorption is very little, estimated at only 6 per cent. An interesting development is the colour-spraying of lamps in red, orange, yellow, green, blue, etc., whereby any desired tint can be given to the light emitted through the translucent coating. Lamps so treated are expected to be very serviceable for decorative use, *e.g.*, in theatres, cinemas, hotels, restaurants, etc.

In another attractively illustrated little bulletin, entitled "Better Home Lighting," the requirements of the various rooms in a typical home are simply explained. The booklet concludes with a few simple hints in regard to avoidance of glare, discarding blackened lamps, etc., and in conclusion the following rough rule for determining the sizes of the lamp (or lamps) is given:—"Multiply the length of the room in feet by width in feet. With gasfilled lamps halving this result will give the total wattage necessary." In other words, as a rough indication, half a watt per square foot of floor area is suggested.

WESTON ELECTRICAL INSTRUMENT CO., LTD.

We are notified by the above company of their change of address. Owing to the prospective expiration of the lease of the present premises, and the need for better accommodation, it has been decided to remove to 15, Great Saffron Hill, London, E.C.1. The present telegraphic and telephone addresses will be retained.

HOLOPHANE ILLUMINATION.

THE publication of *Holophane Illumination*, temporarily discontinued during the war, has now been resumed. The issue now before us (Vol. X., No. 1 ; July, 1924) is devoted mainly to Church Lighting, and it is proposed in future issues to deal with other problems on similar lines.

The lighting of churches is dealt with in several articles, written from the architectural and psychological standpoints. In a contribution on "Light as an Element in Worship," the long standing association of light and religion is pointed out, and the varied requirements of different places of worship are discussed.

Following this we have a series of illustrations, almost all from photographs taken exclusively by artificial light, showing various recent Holophane installations. The churches dealt with include St. Paul's Cathedral, the Cathedral at Bury St. Edmunds, numerous buildings of the Church of England and Non-conformist places of worship. It is stated that the Holophane, Ltd., maintains a staff of capable engineers for the purpose of giving advice and preparing specifications, and that this advice may be obtained by Church authorities free of charge.

In a special Technical Section attention is drawn to the important problem of standard dimensions for lamps and glassware. Reference is made to the formation of a Sectional Committee formed by the B.E.S.A. to deal with illumination and accelerate standardisation in this field. Other readable notes deal with the meeting of the International Illumination Commission and the First International Congress for the Study of Industrial Hygiene, both held in Geneva during July.

We are glad to observe that it is intended, besides describing typical Holophane installations, to continue to include general notes on developments in illuminating engineering. The booklet is printed on special matt art paper and further issues will be awaited with interest.

NEW WELSBACH GAS APPLIANCES.

OUR attention has been drawn to a variety of lighting novelties now being offered by the Welsbach Light Co., Ltd. The new inverted burner has several interesting features. It is fitted with a neat flat-type globe carrier with two wings which can be adjusted to divert all products of combustion from the fittings, thus preventing discolouration. The burner is solidly constructed and equipped with a locking screwed air regulator, permitting very fine adjustment. In addition to this No. 1072 burner the Welsbach Co. have a similar one with brass end on the adjuster arm, the arm being slotted for easy manipulation. The "Eddystone" (No. W. 1079) is another new type, fitted with super-heater chamber and two bijou nozzles; a feature of this is the low gas consumption. Then, amongst other designs we have the "Tuskar," fitted with a 10 in. aluminium reflector and especially suitable for lighting shops, halls, restaurants, etc.

A neat and attractive form of semi-indirect unit is available utilising "Silverstone" three-ply glass, and capable of taking one, two or three-light burners of the new superheater type. The "Silverstone" glass consists of one layer of opal glass between two of clear flint with outside polished satin matted, thus giving exceptionally good diffusion of light coupled with pleasing appearance. In addition this glassware is stated to be distinctly inexpensive in comparison with the usual cost of such material.

In the general catalogue this year, increased space is devoted to silk shades of varied design ; one type, comprising a plain silk top with printed silk base and wood drops, intended for inverted burners of the universal size, is considered distinctly original in design.

We have also before us the catalogue of Welsbach-J. Kern gas radiators for 1924-5 (No. 452). This is got up in a convenient form with a pleasing coloured illustration on the cover.

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THE GAS EXHIBIT AT WEMBLEY.

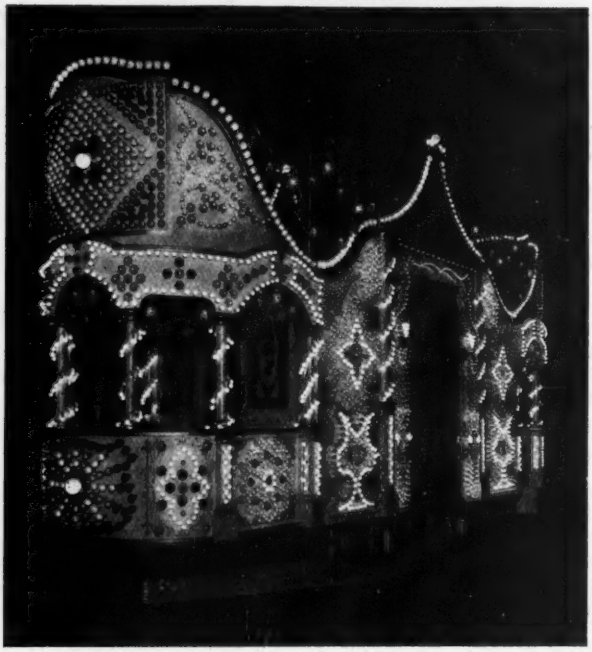
A FEATURE of the Gas Exhibit at Wembley has been the attention devoted to the historical side. The history of ignition and the evolution of the modern match are illustrated by exhibits of fire sticks and bows used by primitive man in the Stone Age to produce fire; examples of flint and steel which gradually superseded them; the flint lock with tinder boxes and steels—contraptions resembling crude-looking pistols—which came in with the Iron Age; the fourteenth century ignition splints tipped with sulphur, potassium chlorate and sugar; the first phosphorous matches introduced in 1827; and the first safety matches which came into use twenty-five years later.

Another instructive display illustrates lighting by oil and wick which came down to us from the time of the early Egyptians at least 3,000 years before the Christian era. All this leads up to the discovery of gas, just about one hundred years ago. The progress of gas lighting is illustrated by examples of primitive gas burners and the very latest modern devices. Finally other aspects of the industry, the use of gas for heating, and the many ramifications represented by the commercial use of bye-product of coal distillation are effectively illustrated.

SMOKE ABATEMENT EXHIBITION.

WE understand that an important conference on Smoke Abatement has been arranged to take place in Manchester during November, under the auspices of the Smoke Abatement League of Great Britain. A series of interesting papers have been arranged. Dr. Leonard Hill and Dr. R. Veitch Clark will deal with "The Effect of Light on Health" and the drawbacks arising from the obscuration of sunlight by the smoke-laden atmosphere of cities. Mr. Samuel Tagg (Past President of the Institution of Gas Engineers) will preside over a session devoted to "The Use of Gas in Smoke Abatement," and Alderman William Walker over a similar section dealing with "The Use of Electricity in Smoke Abatement." We are glad to note the two industries acting together in combating the smoke-evil.

AN ILLUMINATED TRAMCAR.



The accompanying illustration depicts one of the tramcars of the Liverpool Corporation, specially illuminated for a recent gala day. Over 5,000 Osram lamps were used in the various designs, chiefly 12-volt 8-watt lamps run in series from the 500-volt traction supply, and taking in all about 140 amperes. While the main part of the design is outlined with lamps permanently lighted certain sections are controlled by flashers, giving striking colour-change effects. It is understood that the car will serve again for similar festive occasions in the future.

EARLY FORMS OF ELECTRIC LAMPS.

Interesting Relics at Wembley.

SOME interesting relics of early electric lighting are to be seen at the stand of Messrs. S. Rentell & Co., in the Palace of Engineering at Wembley.

These include an original Edison lamp and an original Swan lamp, both used at the Electrical Exhibition at the Crystal Palace in 1882 ; an original Swan United lamp ; a Khotinsky lamp, and another of same type with pink stripes in the bulb—apparently an early attempt to reproduce colour in lighting. Another curious relic is an old fuse carrier made of wood, contact with the fuse wire being made through the medium of wood screws.

"GIRDER" ADJUSTABLE LIGHTING FITTINGS.

IN a booklet issued by the Wardle Engineering Co., Ltd., attention is drawn to the desirability, in industrial operations, of concentrating light where it is mainly needed—at the tool point. The Girder Adjustable Fittings are designed for this purpose. They consist of hinged lattice-work terminating in a lamp in a deep concentrating reflector, so that the position of this lamp can be adjusted and the light directed on any desired spot. It is stated that during the war these fittings proved of great service in shipbuilding, aircraft and engineering factories.